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Haupt, Kevin Paul

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DECISION SUPPORT SYSTEM

by

Kevin P. Haupt

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Thesis Advisor: Donald A. Lacer

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Military system acquisition management decisions can be both untimely and uninformed, according to the author, due to the adverse effects of communication breakdown and filtering of information. An acquisition group decision support system (AGDSS), defined in this thesis, seeks to maintain acquisition team integrity and provide the necessary information processing capacity to mitigate the impact of these effects. The combination of such key technologies as local area networks, word processing, graphics, data base management, and video conferencing, is employed, which can free acquisition team members of mundane paperwork and afford them extraordinary decision making capabilities. These capabilities promise to result in more timely and better informed decisions. An example is provided to illustrate the application of an AGDSS to an acquisition-related problem and to show the benefits that can be derived from the output of the AGDSS. Finally, a system-level specification describing the performance and interface requirements is presented.

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Acquisition Group Decision Support System

by

Kevin Paul Haupt
Captain, United States Air Force
B.S., Norwich University, 1984

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[redacted]

Author: [redacted]
Kevin Paul Haupt

Approved By: [redacted]
Donald A. Lacer, Thesis Advisor

[redacted]
Moshe Zviran, Second Reader

[redacted]
for Carl C. Jones, Chairman
C3 Academic Group

ABSTRACT

Military system acquisition management decisions can be both untimely and uninformed, according to the author, due to the adverse effects of communication breakdown and filtering of information. An acquisition group decision support system (AGDSS), defined in this thesis, seeks to maintain acquisition team integrity and provide the necessary information processing capacity to mitigate the impact of these effects. The combination of such key technologies as local area networks, word processing, graphics, data base management, and video conferencing, is employed, which can free acquisition team members of mundane paperwork and afford them extraordinary decision making capabilities. These capabilities promise to result in more timely and better informed decisions. An example is provided to illustrate the application of an AGDSS to an acquisition-related problem and to show the benefits that can be derived from the output of the AGDSS. Finally, a system-level specification describing the performance and interface requirements is presented.

TABLE OF CONTENTS

I. ACQUISITION GROUP DECISION MAKING

Military system acquisition management decisions are made on a variety of programmatic issues related to program management and functional areas, such as configuration management, contracting, engineering, logistics, manufacturing, program control, and test. Examples include the approval of a design change, the procurement of additional spare parts, the setting of production increments, the approval of functional and physical configuration audits, the synthesis of budget forecasts, and the exercise of contract options.

The above decisions are acknowledged by the Defense Systems Management College to be usually made by consensus (Sellers, 1985, p. 1.5d), because the program manager or his functional managers cannot make a decision in one functional area, such as an engineering issue, without a collateral impact on one or more of the other functional areas. In addition, time and money are two constraints that enter into the decision making process. There is never enough of either one. Acquisition schedules all too often are overly ambitious and, as such, are unrealistic, resulting in less than optimum decisions. Where Research & Development (R&D) is involved, there is little knowledge, if any, of the true capabilities of a contractor to support the R&D activity within the time and budget allotted. Furthermore, schedule slips and cost overruns incurred during R&D tend to complicate the time and money constraints associated with produc-

tion. Occasionally, the acquisition team members are absent or preoccupied with other programs (as is common with matrixed organizations), and decisions are made without a full team's consent. Frequently, the entire team must be gathered together for discussion and/or be engaged in extensive research-discussion cycles. The latter can result in weeks of deliberation which may lead to other problems. Absence of team members and lengthy deliberations provide for what the author defines as untimely and/or uninformed decisions.

Program management decisions generally result from a collection of inputs and or factors (Sellers, 1985, 1.5c) which are in and of themselves time sensitive in most if not all cases. Because the circumstances governing the decision making process(es) are varied, subject to change, and in some instances nondeterministic, a structured environment does not lend itself well to providing a feasible approach to problem resolution. For instance, a manager is briefed regularly on the functional status (engineering, logistics, manufacturing) of his or her program. Each functional area, albeit an integral part of the remaining areas is segregated for management oversight. Despite the manager's skill to delegate to his or her functional experts, the segregation of responsibility leads to the occurrence of "holes" in the management umbrella. Things inevitably "slip through the cracks", either because the dispersion of program team members within a matrixed organization causes communication

breakdown or because unforeseen events occur. Likewise, the program manager is routinely responsibile for reporting a program's status regarding such issues as funding, schedule(s), and progress on resolution of test discrepancies to his or her boss* (Sellers, 1985, p. 1.5c). When a program is in its infancy, all indicators are generally satisfactory (green). Then as time passes, milestones begin to slide and problems begin to surface. If dealt with up front the impact of these problems can be reduced. However, more often than not, things are neglected or hidden until it is too late to capitalize on opportunities beneficial to the outcome. This benign neglect can be attributed to the inherent nature of the acquisition environment, where a preponderence of data, systems, and dynamics of schedules necessitates the filtering of information. This filtering seeks to limit the quantity of information as well as the alternative decisions the decision maker has available. Decision outcome(s) is/(are) made based on neither all the information available nor the flexibility given by weighing the feasible options. Neglecting to consider all the factors and options regarding a decision imposes a bias(struc-

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* The term boss shall hereafter be referred to as the director of programs, the title given to the author's immediate supervisor while the author served as program manager. The director of programs is a middle management position and should not be confused with the newly created executive level position of program executive officer (PEO).

ture) on the decision making process. This structure may lead to an untimely and/or uninformed decision.

The untimely and/or uninformed decision is an extremely common one that to date has repeatedly led to the acquisition of systems that did not perform to the intended specifications. Not only have systems been accepted into the inventory at substandard performance levels, but as a result, down the road these systems may accrue a higher life cycle cost, or compromise operator safety, and can also result in a mutual distrust between government and industry.

A group decision support system (GDSS) can provide acquisition team decision makers the best information resources possible with which to formulate and execute their decisions. It can do so by maintaining team integrity on a daily basis as well as maintaining corporate knowledge when personnel get reassigned. The physical implementation of a GDSS is the local decision network (LDN) (see Figure 1, Desanctis and Gallupe, 1985, p.195). The LDN is a local area network (LAN) of individual decision support system (DSS) terminals. In addition to the standard LAN protocols, the LDN requires facilities to control both how and what type of information should be exchanged (see APPENDIX p. 2, para. 3.1.1.1). Aside from its importance as a communications link any further discussion of the LAN portion of the GDSS is reserved for the system specification found in the

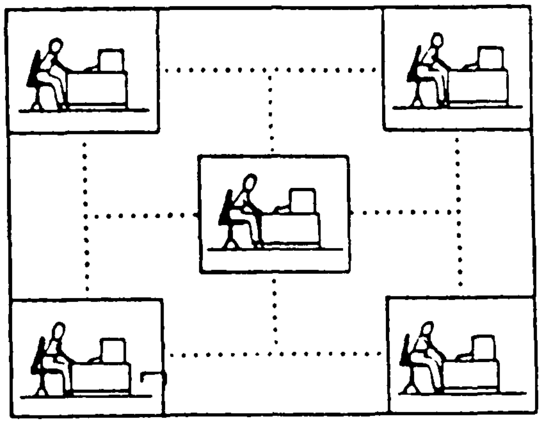

Figure 1 Local Decision Network

APPENDIX. Thus only the DSS is explored further in this document. The enhanced capability to seize opportunities as well as to seek additional initiatives is facilitated by an acquistion group decision support system (AGDSS) (for both government and contractor). It can provide for a more effective acquisition environmment.

The AGDSS's primary role would be to both coordinate and facilitate the daily transfer of information among program team members and to aid the decision processing needs of the program manager and the team. Secondly, the AGDSS would be tasked to provide reports to the director of programs as required. Finally, the AGDSS would support "what if" type decision making, that is foresighted with the goal of determining current decisions by which to avert problems downstream. The "what if" capacity of the AGDSS would also be helpful in searching for possible schedule slips or other

program impacts due to potential risk taking on the part of the program manager.

In order to maintain the continuity of corporate knowledge as personnel are reassigned, the AGDSS would provide, via its libraries, repositories of information. Unlike traditional Management Information Systems/Electronic Data Processing (MIS/EDP) systems, this data will be more potentially exploitable by the successors of those that create it via the flexibility and unstructured design of the AGDSS subsystems.

II. INTRODUCTION TO DECISION SUPPORT SYSTEMS

A. DEFINITION

A decision support system (DSS) is an interactive computer-based system to aid decision makers in utilizing data and models toward the solution of unstructured problems (Sprague and Carlson, 1982, p. 4). The distinction between structured versus unstructured problems is fundamental to understanding the difference between traditional computer systems and DSS. The former employ structured algorithms which must be executed sequentially with little or no opportunity for user modification. A DSS, on the other hand, affords the user the flexibility to alter both the content and sequence of the programs; hence the reason for their being characterized as unstructured. The interactive nature of the system, to include widespread sharing of data and program modules, results in a unique modeling capability with a DSS.

B. THE DSS IN THE INFORMATION WORLD

1. The Connotational View

Figure 2 (Sprague and Carlson, 1982, p. 7) shows the relationship between three levels of sophistication in the information systems world. EDP as the first of these continues to perform the basic operations of data storage and processing with summary reports (little more than data

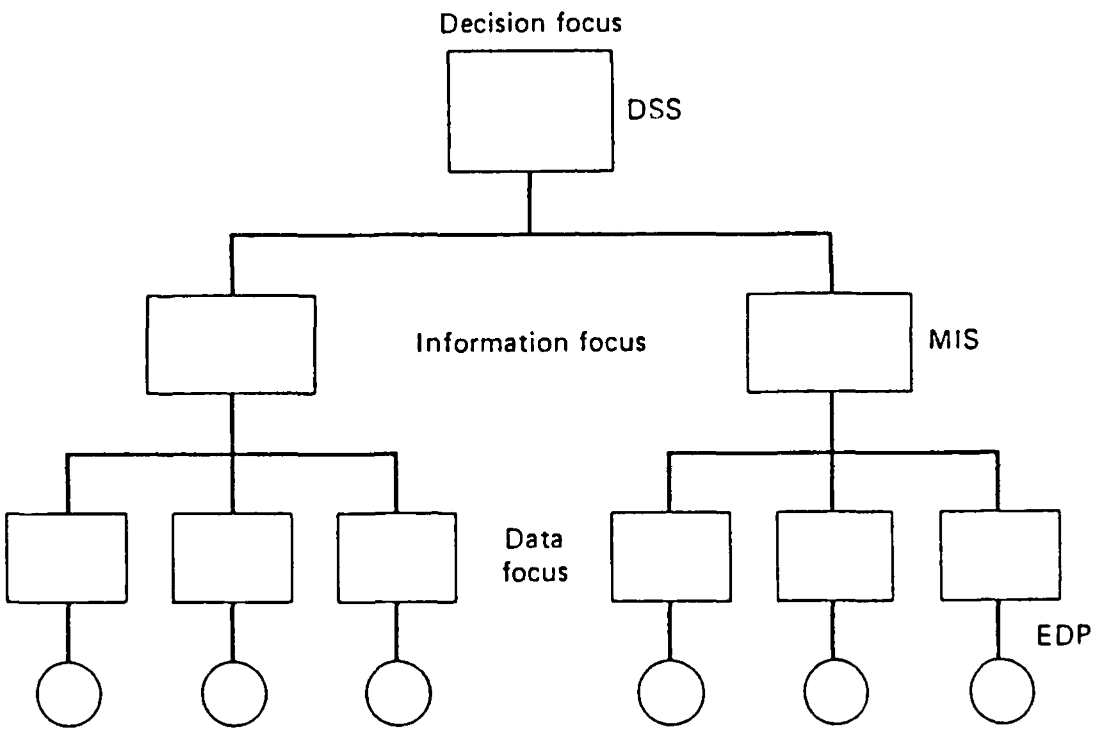

Figure 2 The Connotational View

listings) for management as its major product. MIS improved on the EDP concepts of planning and integration at the operational level, providing middle management with information management via data base capabilities. A need to provide executive management with a decision aid remained largely unaddressed by EDP/MIS technology. A DSS can provide top managers as well as their subordinates, with quick, user friendly, and individually tailored decision support.

2. The Theoretical View

From a theoretical standpoint a DSS is looked upon as:

> Dedicated to improving the performance of knowledge workers...whose primary job...is the handling of information in some form...in organizations through the application of information technology. (Sprague and Carlson, 1982, p. 8)

Figure 3 (Sprague and Carlson, 1982, p. 9) depicts in a classical sense the dimensions of an information system. Levels of management are represented vertically and functional activities are represented horizontally and labeled as "Interactive models", where the acronyms OR/MS and DC/OA/WP, represent Operations Research/Management Science and Data Communications/Operations Analysis/Word Processing respectively.

The third, or systems dimension is comprixed of information systems providing support to the knowledge workers. While advances in office automation and telecommunications

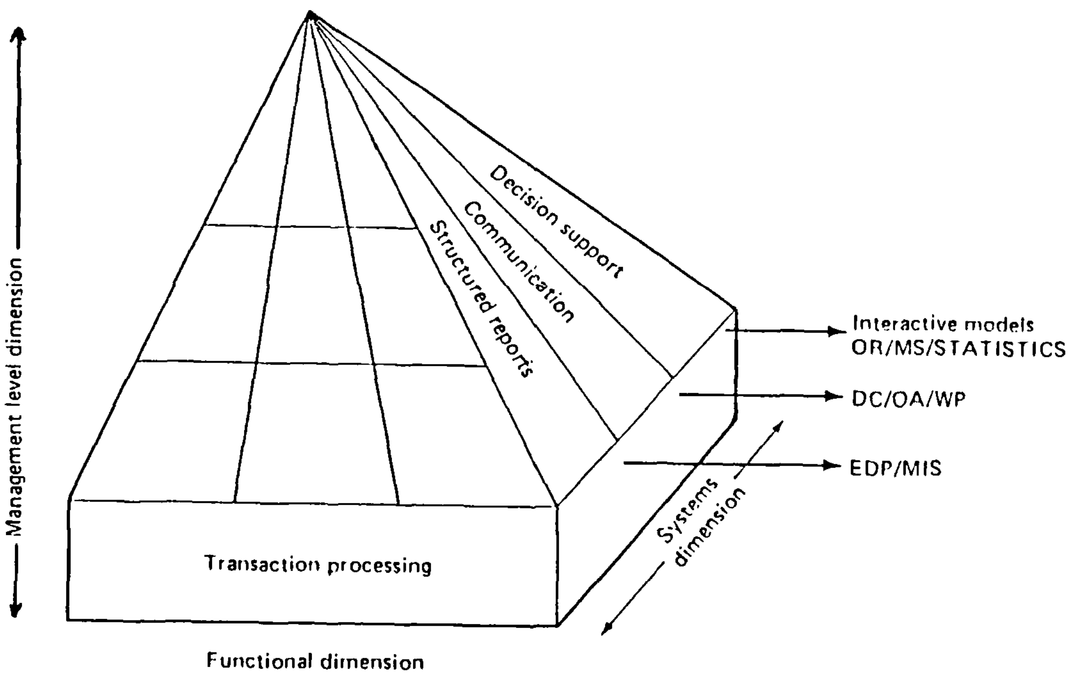

Figure 3 The Theoretical View

improve the performance of these systems, the combination of information technology and operations research/management science via interactive modeling, pushes the evolution of the DSS.

C. VIEWPOINTS

The process of building a DSS is looked upon from three viewpoints; those of the users, the builders, and the toolsmiths. The users are concerned with the problem solving or decision-making task support that the DSS will provide. The builders' interest lies in designing capabilities into the DSS to support the users. The toolsmiths involve themselves with the integration software to form DSS generators in support of the builders.

From the users' perspective, DSS performance can be measured in terms of performance objectives. The builders view DSS performance in terms of three characteristics: (1) user interface (dialog handling), (2) data base and data base management, and (3) modeling and analytic capability. The toolsmiths share the builders' view but focus on the underlying architecture of these characteriscs.

1. The User

The following paragraphs describe six performance objectives by which a user measures DSS performance.

a. Semistructured/Unstructured Decision Support

EDP/MIS are of little use in this environment of underspecified problems where the structure of the decision

process depends significantly upon the style of the decision maker.

b. Multi-level Decision Support

Users at all levels of the decision making process require integration and coordination of their efforts toward total problem solution.

c. Independent/Interdependent Decision Support

The former provides a decision maker sole authority for a decision whereas the latter connotes the sharing of the decision making process with others. Sequential interdependent decision support is the passing along of a decision to successive decision makers for action. Pooled interdependent decision support results in arbitration among decision makers.

d. Multi-phase Decision Support

Figure 4 illustrates Simon's Intelligence, Design, Choice (IDC) paradigm (Sprague and Carlson, 1982, p.26), a three-phase decision making model. The double headed arrows at the left of the figure indicate a series of feedback loops among the phases of this operations process:

Intelligence - Acquiring information about the environment, processing that information for clues leading to conditions requiring decision making.

Design - Problem formulation and testing the feasibility of possible solutions.

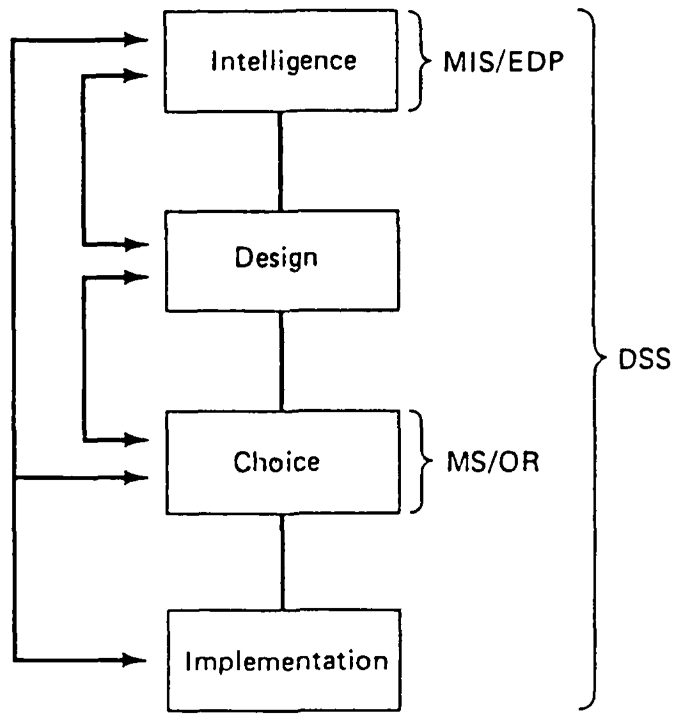

Figure 4 Phases of Decision Making

Choice - Choosing from the selection of possible solutions and implementing that choice.

e. **Process Independent**

The DSS must have the ability to support a variety of decision-making processes. Rather than depend on a particular process it must instead, both conform to the individual cognitive style of the decision maker and be under his or her control.

f. Ease of Use

The DSS must be user friendly and flexible in order to attract user allegiance. For unlike the EDP/MIS environment, decision makers, by virtue of their position in the organization, can refuse to be inconvenienced or intimidated by a computer system, especially if it doesn't meet their needs.

2. The Builder

Although the builder has the option to construct the DSS from DSS Tools (hardware and software used to develop DSS generators), it is usually more practical to use DSS generators possessing initial capabilities which can be modified to satisfy the user's needs based on changes in the environment, tasks, and the user (see Figure 5, Sprague and

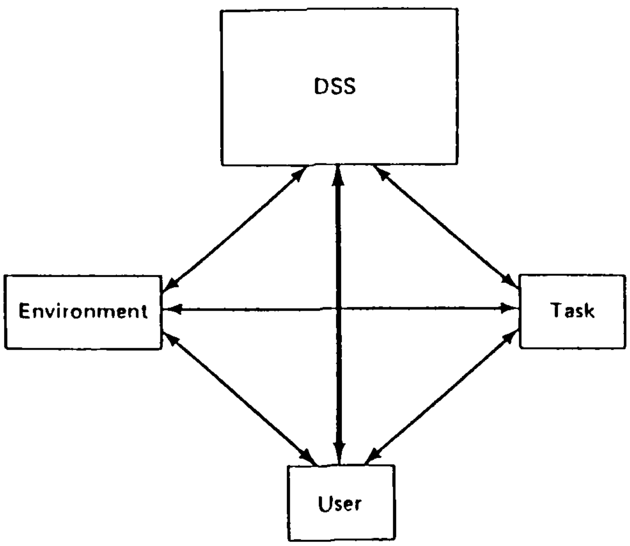

Figure 5 The Decision-Making System

Carlson, 1982, p. 28). The initial DSS can be thought of as a succession of black boxes containing subsystems within each. Referring to Figure 6 (Sprague and Carlson, 1982, p. 29), within the DSS box are the data base, model base,

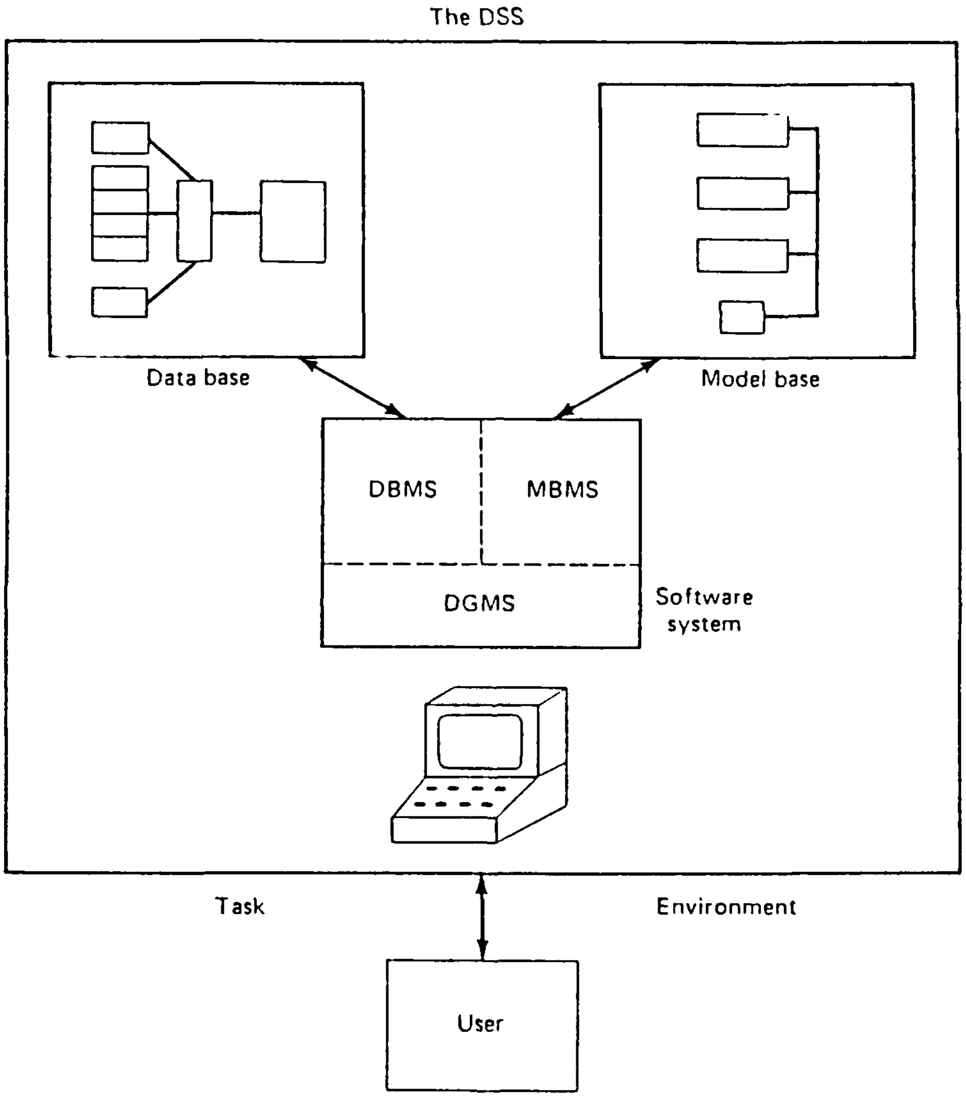

Figure 6 Components of the Decision Support System

and a software system which is further comprised of dialog generation and management software (DGMS), data base management software (DBMS), and model base management software (MBMS).

a. The Dialog Subsystem

While the user, terminal, and software comprise the components of this subsystem, the experience (Sprague and Carlson, 1982, p. 30) consists of the action language, the display or presentation language, and the knowledge base (see Figure 7, Sprague and Carlson, 1982, p. 30). The

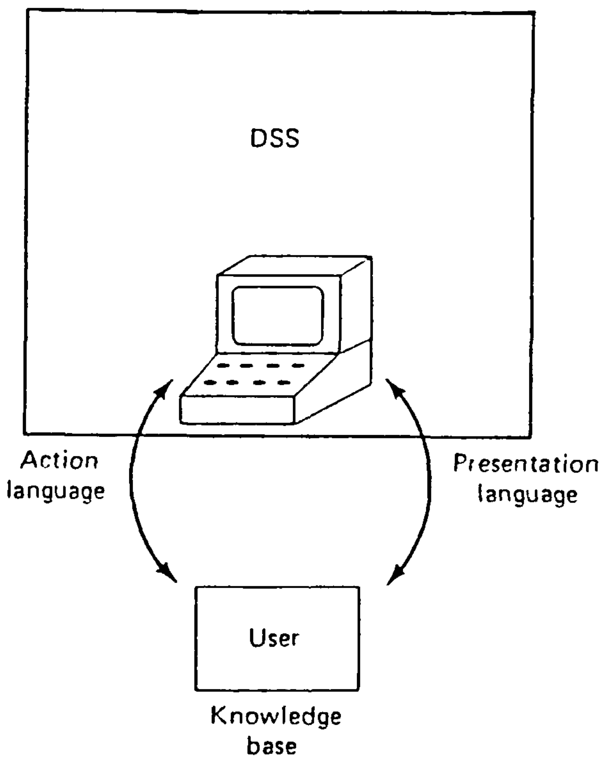

Figure 7 The Dialog Subsystem

action language is the means by which the user communicates with the system, a mouse or keyboard for example. The presentation language is what the user sees such as a screen or printer output. Finally, the knowledge base is the knowledge the user brings to the system.

b. The Data Subsystem

Figure 8 (Sprague and Carlson, 1982, p. 31) illustrates the extensions of the DSS data base which suggest the DSS demands more from its data base management system than an EDP/MIS system. In addition to its internal

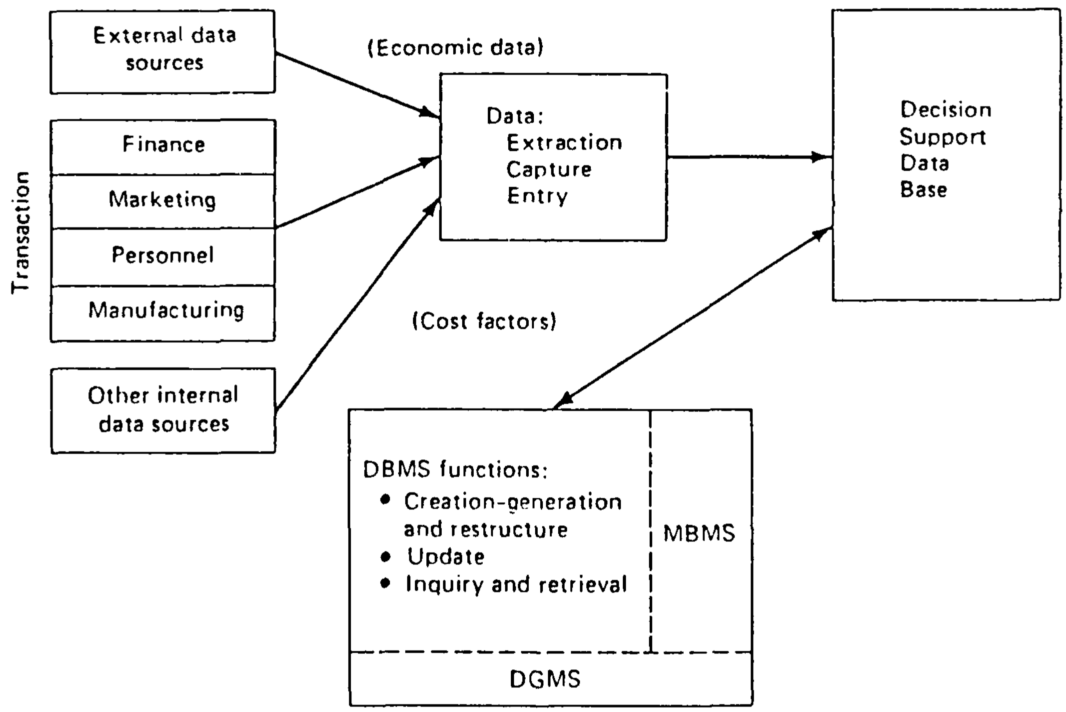

Figure 8 The Data Subsystem

data , the DSS requires data from external sources to acquire the information necessary for decision making. To accomplish this, the data subsystem has a data capture and extraction capability for rapid access and update of data.

c. The Models Subsystem

The capability derived from this subsystem to integrate data retrieval and reporting from EDP with techniques from the management science arena are what distinguish the DSS's potential from that of its predecessors as a decision aid. Figure 9 (Sprague and Carlson, 1982, p.33) illustrates the models subsystem component. The models are assembled from a set of building blocks much like subroutines. A set of model management functions similar to those of data base management provide the capability to assemble, catalog, and interrelate the models quickly and easily.

3. The Toolsmith

The toolsmith is involved with the science and engineering aspects of information technology in relation to the builder's model of DSS previously described. Experimental and theoretical work continues in systems requirements for dialog management. Improvements in handling both time series data and probabilistic data are sought for data management. Finally, artificial intelligence (AI) is expected to expand upon existing what if modeling capability derived from the formulation of interrelationships between variables.

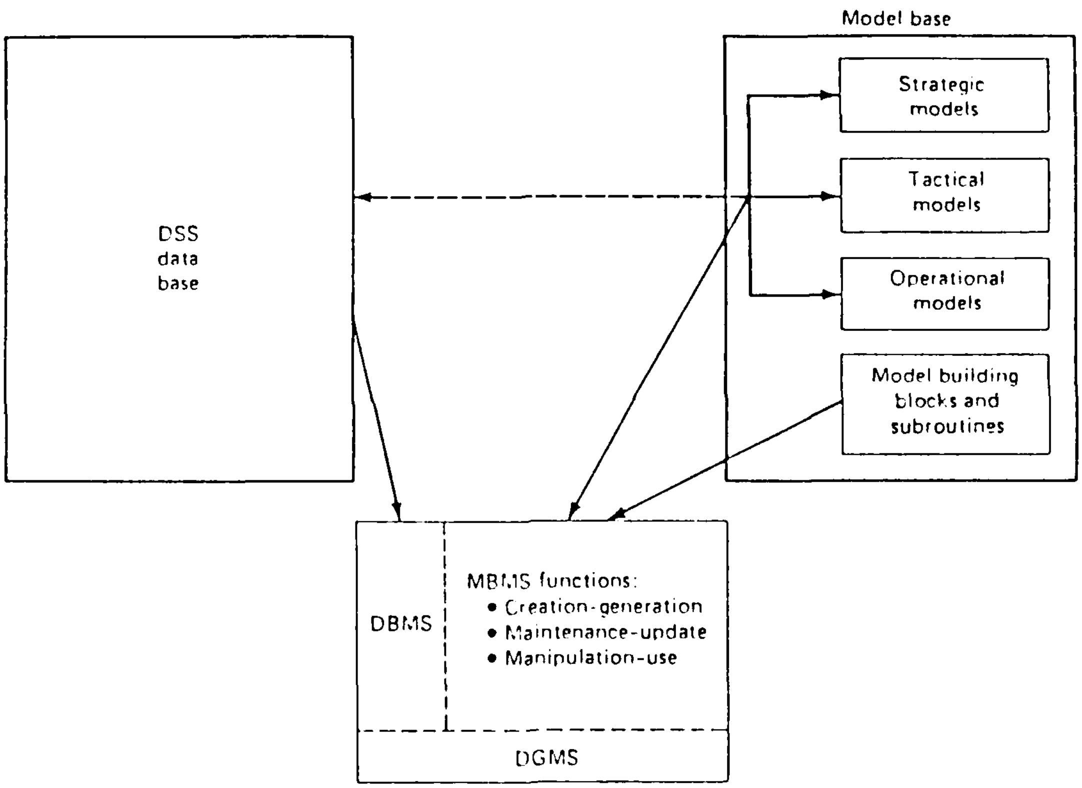

Figure 9 The Models Subsystem

D. THE REPRESENTATIONS, OPERATIONS, MEMORY AIDS, CONTROL MECHANISMS (ROMC) FRAMEWORK

The (ROMC) Framework provides a process independent approach to systems analysis for DSS.

1. Representations

Decision makers must physically represent information or media such as paper, blackboards, transparencies, etc. to communicate some concept. The following are some examples in the IDC format:

Intelligence

- Identify problem to be solved
- Formulate objective function and constraint equations
- Write the equations

Design

- Load and run the equations in a linear program
- Modify the equations

Choice

- Compare range of feasible solutions
- Select the appropriate solution

2. Operations

As discussed previously the IDC model describes the operations process. The following illustrates some examples in the IDC format:

Intelligence

- State the problem
- Develop a plan
- Organize a team
- Implement the plan
- Manage the plan's implementation

Design

- Conduct fact finding to obtain information
- Organize the information
- Validate the findings
- Evaluate the facts
- List the options
- Consider the associated risks for each option

Choice

- Compare the risks
- Choose an option
- Justify the choice

3. **Memory Aids**

Memory Aids support the use of representations and operations as illustrated below:

- A data base from sources internal and external to the organization
- Views(aggregations and subsets) of the data base
- Workspaces for displaying the representations and for preserving intermediate results as they are produced by the operations
- Libraries for saving workspace contents for later use

- Links for remembering data from one workspace or library that is needed as a reference when operating on the contents of another workspace
- Triggers to remind a decision maker that certain operations may need to be performed
- Profiles to store default and status data (Sprague and Carlson, 1982, p. 104)

4. Control Mechanisms

Control mechanisms aid the decision-maker in utilizing representations, operations, and memory aids in the decision-making process in accordance with their individual cognitive abilities. The mechanisms range from menus or function keys to help commands and procedures for adding or modifying commands.

III. THE DESIGN AND IMPLEMENTATION PLAN FOR THE AGDSS

A. DESIGN CONSIDERATIONS FOR THE AGDSS

The AGDSS will support an iterative design capability with a configuration that is flexibile to change as the needs of its users evolve. It will be developed in accordance with the ROMC framework with the following capabilities:

1. Automate the storage, processing, and retrieval of documentation
2. Generate reports, including graphics and spreadsheats
3. Provide windows containing integrated text, graphics, and video displays
4. Support local area networking
5. Be easy to use.

B. SYSTEM CHARACTERISTICS

The AGDSS consists of computer terminals networked together. The acquisition team will use the system to conduct group decision making via menu configurations corresponding to program management and functional area. All AGDSS terminals will have identical main menus. The submenu configurations fall into three basic categories:

1. Task menus listing management or functional area tasks
2. Window setup menus for display of multimedia sources

of documentation, correspondence, spreadsheet, graphics, and video.

3. Communications menus configuring communication modes and channels.

C. AGDSS SUBSYSTEM

1. The Dialog Subsystem

a. Using the ROMC Approach

The dialog subsystem corresponds to the representations and control mechanisms of the ROMC approach. The AGDSS terminals will utilize window software to partition screen displays combining video, text, and graphics from a variety of sources as is illustrated in the following example.

b. Example for the Dialog Subsystem

Suppose the program manager has just been confronted with the following problem: the contractor writes the government to contest failing a government conducted test of a device. The program manager, with the consultation of the test and engineering functional managers, must decide whether or not the test procedure involved in the test is valid or is overspecified. If valid, does a contractual obligation exist? If so, is it beneficial to the government to uphold its position?

c. Dialog Sequence

The above decision is indeed complex, and will call for something similar to the following dialog sequence to provide the program manager with a set of feasible solutions to the problem.

(1) Main Menu. The program manager will initialize the AGDSS by selecting "Program Management" from the Main Menu which will bring up the Program Management Task Menu (see Figure 10).

```
                 Main Menu

    1       Program Management
    2       Configuration Management
    3       Contracting
    4       Engineering
    5       Logistics
    6       Manufacturing
    7       Program Control
    8       Test


    Select Option <1-8>
```

Figure 10 Main Menu

(2) Program Management Task Menu. The program manager selects "Correspondence", "Documentation", and "Problem Solving" from the Program Management Task Menu to acquire information about and to build a model for a decision making process to solve the problem (see Figure 11).

<u>Program Management Task Menu</u>

1	Budget
2	Communication
3	Correspondence
4	Documentation
5	Schedules
6	Meetings
7	Problem Solving

Select Option <1-7>

Figure 11 Program Management Task Menu

(3) Information Windows. The program manager will use Information Windows to display the Problem, "What if", and references, to the Test Procedure, Specification, and Contract (see Figure 12).

Information Windows

Problem	"What if"....................
....	....
....	....
....	....
Test Procedure	Contract ....
....	....
....	....
....	....
Specification	....
....	....
....	....
....	....
....	....

Figure 12 Information Windows

(4) Modeling Windows. After reviewing the documentation and reflecting on the problem, the program manager uses the Modeling Windows to call the "Linear Program" option, to explore the "what if" under consideration via "Compute Solution" (see Figure 13).

Modeling Windows

Linear Program	"What if" Opportunity Cost Objective Function:
	$Z = 2X1 + 3X2$
Build a Model	
Revise a Model	Constraints:
Change Data	$X1 + X2 = 1000$
Compute Solution	$X1 + 2X2 = 2000$
	$X1 + 3X2 = 4000$

Figure 13 Modeling Windows

The independent variable X1 denotes the number of collateral test procedures impacted by waiving the given test procedure. Similarly, X2 is the number of engineering change procedures required to make the failed device test compliant.

The first constraint limits the number of total procedures to be implemented, while the latter two constraints bound the number of hours for planning and implementation respectively. Both X1 and X2 are positive integer values.

(5) Basic Solutions Window. The program manager is provided a number of feasible (all variables are

positive integer values) and infeasible solutions from which to choose. Although it is likely that the infeasible solutions would be discarded from further consideration, several feasible options remain. The program manager will now consult with test and engineering to try to determine which of these options is most practical. The ensuing discussion might result in a less than optimal solution being chosen due to factors not modeled in the linear program (see Figure 14).

(6) Task Menu. The program manager returns to the Program Management Task Menu to set up a meeting via LDN computer conferencing, by selecting "Meetings" and "Communications" (see Figure 11).

Basic Solutions Display

Basic Solutions X1	X2	S1	S2	S3	FEASIBLE/ INFEASIBLE
(0)	(0)	1000	2000	4000	Feasible
(0)	700	200	200	(0)	Feasible
150	600	75	(0)	(0)	Feasible
.	.	.	.	.	....
.	.	.	.	.	....
.	.	.	.	.	....
275	550	(0)	-130	(0)	Infeasible

Figure 14 Basic Solutions Display

(7) Meetings and Communications Menu. Meetings and Communications options are displayed in the Meetings and Communications Menu and "Team" and "Video Conferencing" are selected (see Figure 15).

```
Meetings and Communications Menu

        Meetings
        1      Team
        2      Program Management
        3      Engineering
        4      Logistics

        Communications

        1      Electronic Mail
        2      Video Conferencing

        Select Options <1-4,1-2>
```

Figure 15 Meetings and Communications Menu

(8) Team and Meeting Agenda Menu. The program manager selects "Test" and "Engineering" from the options listed under "Team" and all of the options under Meeting Agenda from the Team and Meeting Agenda Menu. (see Figure 16).

__Team and Meeting Agenda Menu__

Team

1	Configuration Management
2	Director of Programs
3	Contracting
4	Engineering
5	Logistics
6	Manufacturing
7	Program Control
8	Test

Meeting Agenda

1	Problem
2	Document
3	Search
4	Modeling
5	Solutions
6	Decision

Figure 16 Team and Meeting Agenda Menu

(9) Conferencing Windows. In Figure 17, the test manager (upper left, Perry, 1989, p.44), and the engineering manager consulting with his engineers (lower left, Santo, 1988, p. 54), appear in the video conferencing windows. The meeting agenda, to be supplemented with other text, graphics, etc. appears to the right of the figure. The conference will either conclude with a decision on whether or not to uphold the government's position, or set the stage for another dialog session to try to resolve the problem. The video conferencing capability affords the team instantaneous face to face contact without requiring them to

leave their work areas. By remaining in their work areas, team members save time normally taken to gather at a separate location, in addition to the added convenience of having immediate access to their work areas, should the need arise.

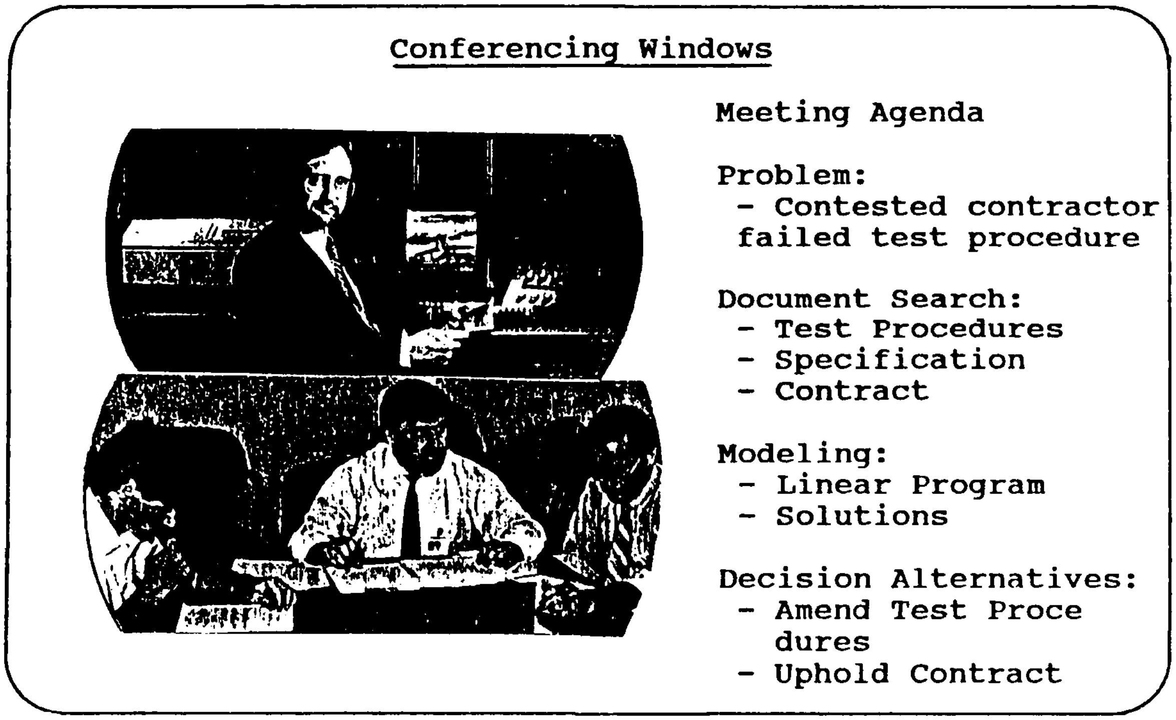

Figure 17 Conferencing Windows

2. Data Base Subsystem

The relational data base incorporates seven primary relations that provide task performance from the AGDSS terminal corresponding to the task menu discussed in the example of Subsection, III C1b. These relations are:

1. Budget - containing the year and amount.
2. Schedule - records the type, event, start, and finish.

3. Meetings - logs the meeting name, date, time and location.
4. Problem - contains the problem number, description, priority, and urgency.
5. Correspondence - tracks correspondence number, to, from, date, and subject.
6. Documentation - includes document number, page(s), section, and paragraph.
7. Communications - holds the medium and link data.

In addition to the creation, update, and retrieval operations, the data base shall have the capability to "extract" data from external sources. The extraction procedure produces local data bases which are subsets, aggregates, or some combination of the two, which are smaller than the source data bases they are derived from. The reduced size combined with better indexing, provides for faster access times for enhanced system performance. These external sources might be within or outside the physical confines of the AGDSS. Since the data base is distributed, each of the functional area data bases would be considered external to the program manager's terminal, yet within the confines of the AGDSS. In the example of Subsection III C1b, the program manager's data base uses extraction (see Figure 18) to obtain the test, specification, and contract documentation from test, engineering, and contracting respectively. These documents are maintained by the respec-

documentation from test, engineering, and contracting respectively. These documents are maintained by the respective functional managers, only to eliminate redundancy while ensuring data integrity. Extraction is also performed on the program manager's internal data base files containing program status, model base parameters, and correspondence. It is possible that data extraction could include external

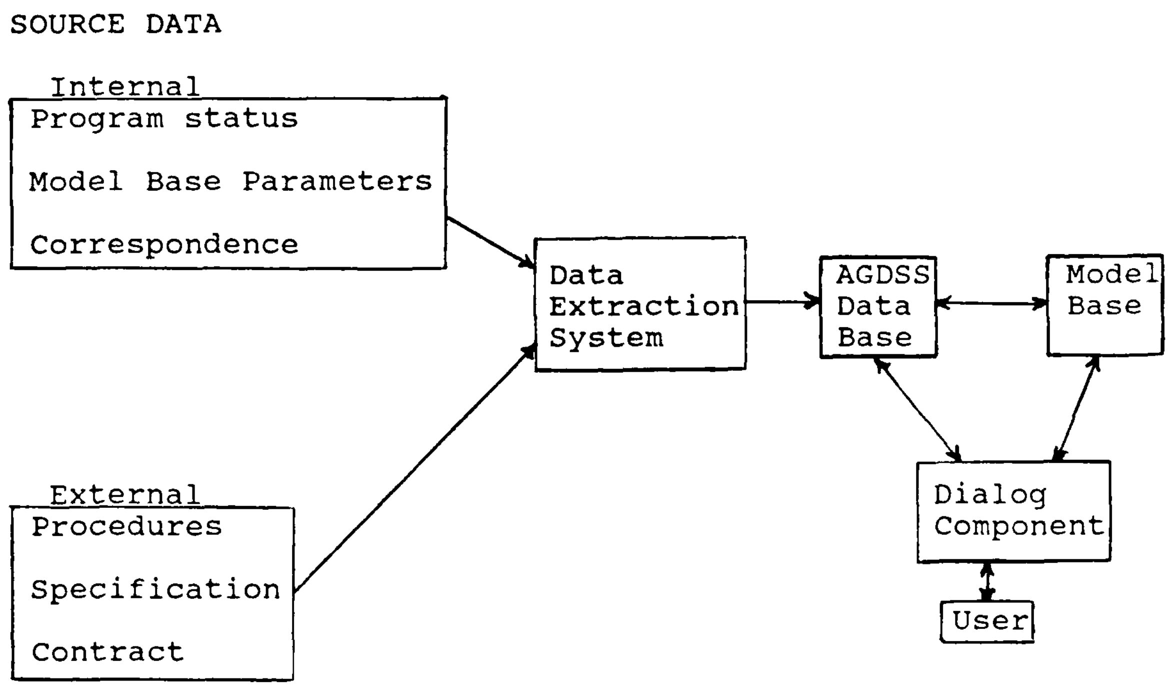

Figure 18 AGDSS Data Base Data Extraction Feature from the Program Manager's Perspective

connections via a wide area network (WAN), to other participating government agencies and contractors. Since the program manager will exchange a great deal of information up the chain of command, it will be necessary to provide extraction between the program manager and his immediate superior, the director of programs, who will be connected to the AGDSS as well.

3. Model Base Subsystem

a. Model Base Description

The model base will consist of a variety of subroutine like building blocks as mentioned earlier which can be combined to form models to support the three levels of decision making: strategic, tactical, and operational. Regardless of the level invoked, the same basic steps for exercising the model base subsystem occur via links to the dialog subsystem and data base subsystem. Intermodel links also exist between the three levels when called upon. First, the model is selected and assembled from the basic building blocks stored in the model base. Once assembled, the model loads the necessary parameters requested by the user from the data base. Next, the model is executed, granting the user the option to interrupt the process at any time to check intermediate or final results, or to change parameters and/or sequencing. Upon completion of execution,

the model places the results in the data base and signals the user that it has finished execution.

b. Example for the Model Base Subsystem

Following the example from Subsection III C1b, Figure 19 shows the three levels of modeling involved in deciding what to do about the contractor's failure of a government test procedure. For each level, the first column shows the inputs, the second column shows the extracted data base, and the third column shows the linear programming model employed for that level.

The director of programs strategic model and the test and engineering operational models are separately linked to the program management tactical model. The director of programs having updated the funding data with the latest Program Objective Memorandum (POM) figures, is concerned about the consequences of decisions at subordinate levels which affect major expenditures. The director, after a video conference with the program manager, may decide to cut or cancel the program (which might obviate the problem at the subordinate levels), in light of long range funding and the program's status and priority measured against other programs. Recall the "what if" opportunity cost objective function of the tactical model from the dialog example, Subsection III C1b. This model's data is updated by a contract letter which establishes the objective of minimiz-

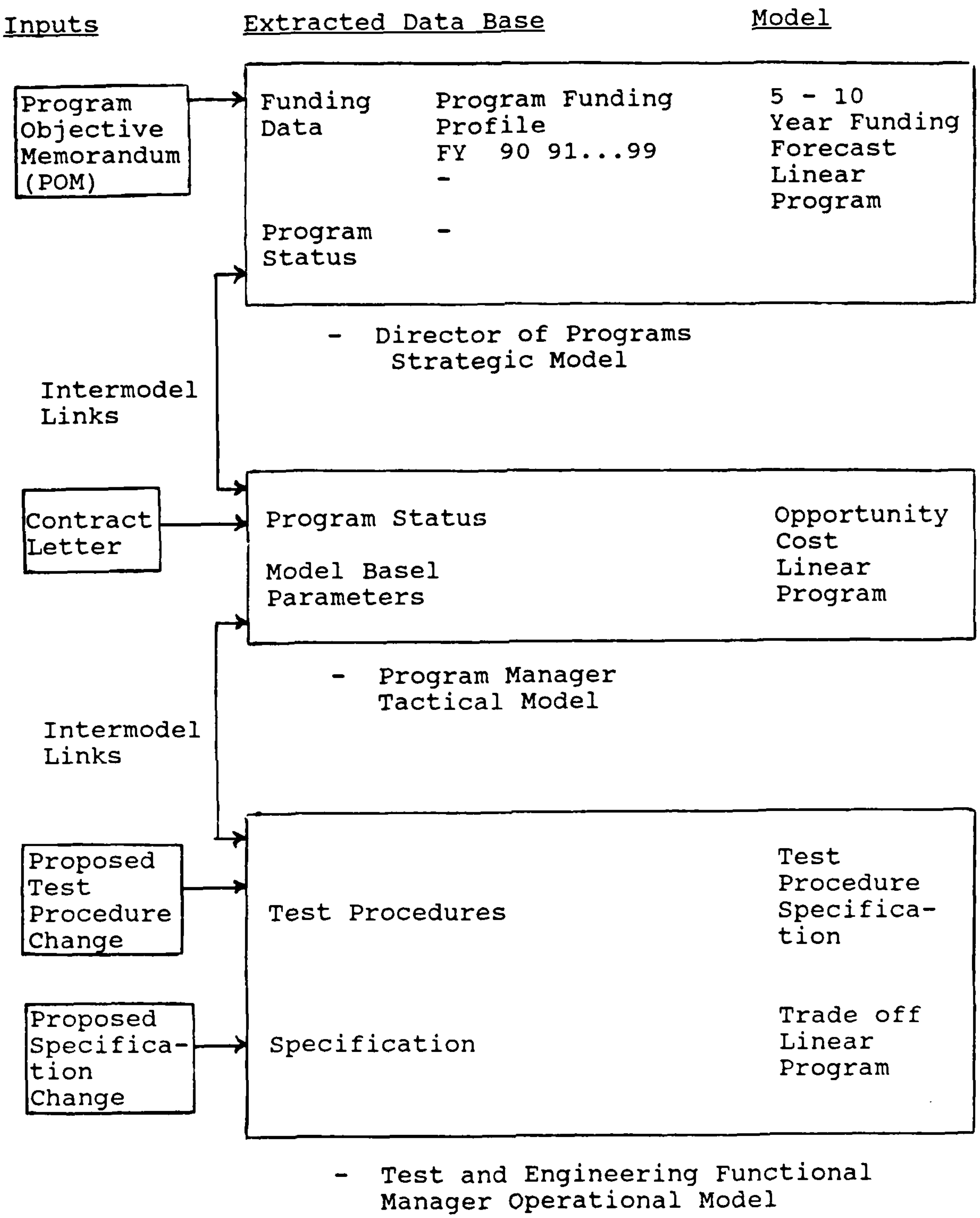

Figure 19 AGDSS Three Level Model Base

ing the cost to the government of upholding the test procedure, and subjecting the government to contractor claims, versus changing the procedure and any collateral procedures to accommodate testing. The proposed test procedure and design changes fed into the data base, drive the operational model, which supports the tactical model by providing the constraints to the latter model's objective function. These constraints are derived by exploring possible answers to the basic questions. First, was the test procedure valid or over specified? If valid, does a contractual obligation exist on the contractor's part? Finally, if so, how beneficial is it for the government to pursue consideration from the contractor?

4. Outputs

While the AGDSS is constantly processing input and output during the dialog sequences, it is also accomplishing other mundane and labor intensive tasks with much greater efficiency than the manual methods relied upon currently to prepare and process program documentation. In the example, the program manager retrieves excerpts from the test, specification, and contract documentation, which is maintained by the functional managers via the AGDSS. In addition, the AGDSS will record dialog sessions, video conference meeting minutes, and other historical information. A serious shortcoming of meeting minutes currently, is the tendency for the person recording minutes to omit or misinterpret, key infor-

mation during a meeting or while translating a tape recording of the meeting. Furthermore, the minutes review process can take days, even weeks, requiring preparation, distribution, review and correction. By the time the minutes become available for review, the events that transpired are no longer fresh in the minds of those reviewing the minutes, making it nearly impossible to judge whether or not the minutes as recorded are both accurate and complete. Incomplete and/or inaccurate minutes are a prime source of communication breakdown and its related problems (see Chapter I, p. 2). The AGDSS will preclude human error in recording the minutes and the expensive and time consuming review process which is required to compensate for that error.

The program manager as well as the functional managers invest significant amounts of time preparing reports and briefings to the deputy for programs. Much of their effort would be replaced by the AGDSS. Relieved of the mundane and time consuming tasks associated with preparing view graphs and typing reports, the managers can devote their time to managing their functional areas, with the only burden being that of maintaining the AGDSS data base, from which both timely and informative reports and briefings will be derived. Thus the untimely and/or uninformed decision (see Chapter I, p. 3) is a less likely result of AGDSS generated reports and briefings.

D. SUMMARY

The foregoing example demonstrates the advantage a decision support system can afford to the acquisition group in decision making. Through the dialog subsystem, the director of programs, program manager, and functional manager can effortlessly contact each other and obtain required program document references without filtering important information. Insights provided by these references can be objectively modeled to arrive at a set of timely and informed alternative decisions. Furthermore, dialog sessions, such as the example, can be archived for future reference, an invaluable capability which has no equal in the non-DSS world.

APPENDIX

SS-AGDSS-00001A
09 April 1990

SYSTEM SPECIFICATION
FOR THE
ACQUISITION GROUP DECISION SUPPORT SYSTEM

TABLE OF CONTENTS

1. SCOPE

1.1 Scope. This specification establishes the performance and interface requirements for the AGDSS.

2. REFERENCED DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

SPECIFICATIONS:

Military

SS-CSOC-00001B 84 Apr 16	System Specification for the Consolidated Space Operations Center

STANDARDS:

Federal

DOD-5200.28-STD December 1985	Department of Defense Trusted Computer System Evaluation Criteria

Military

AFOSH STD 127-64 79 Mar 03 IMC 80-1 81 Jan 19	Data Processing Facilities
MIL-STD-454H 82 Jul 30 Notice 1 82 Sep 01	Standard General Requirements for Electronic Equipment
MIL-STD-490A 85 Jun 4	Military Standard Specification Practices

2.2 NON-GOVERNMENT DOCUMENTS

SPECIFICATIONS: Reserved

STANDARDS: Reserved

OTHER PUBLICATIONS:

Bui, T., and Jarke, M., "Communications Requirements for Group Decision Support Systems," paper presented at the Nineteenth International Conference on System Sciences, University of Hawaii, Honolulu, Hawaii, January 1986.

Bui, T., Jarke M., and Shakun, M.F., "Non-Cooperation in Group Decision Support Systems Many Problems and Some Solutions," SCIMA, Journal of Management Science and Cybernetics, V. 18, Nos. 1-2, pp. 51-63, 1989.

Chorafas, D.N., Computer Networks for Distributed Information Systems, Petrocelli Books Inc., 1980.

NCSC-TG-005 31 July 1987	Trusted Network Interpretation of the Trusted Computer System Evaluation Criteria
NCSC-TG-008 15 December 1988	A Guide to Understanding Trusted Distribution in Trusted Systems

Sprague, R. H., and Carlson, E. D., Building Effective Decision Support Systems, Prentice Hall, 1982.

3. REQUIREMENTS

3.1 SYSTEM DEFINITION

This specification defines the performance and interface requirements for the Acquisition Group Decision Support System (AGDSS). The AGDSS combines such key technologies as local area networks, word processing, graphics, data base management, and video conferencing, which can free acquisition team members of mundane paperwork, and afford them extraordinary decision making capabilities. These capabilities promise to result in more timely and better informed decisions.

3.1.1 General Description

The AGDSS is composed of four subsystems:
- Communications,
- Dialog,
- Data Base, and
- Model Base.

These subsystems are discussed below.

3.1.1.1 Communications Subsystem (CS)

The CS provides the local area network (LAN) network architecture functions, interfaces, and protocols (Chorafas, 1980, p.74). In addition, the CS indicates to individual DSS not only how to communicate, but also what type of information should be exchanged. (Bui and Jarke, 1986, p. 11)

3.1.1.2 Dialog Subsystem (DS)

Dialog between the user and the DSS is accomplished via the DS. The DS consists of facilities to perform the man-machine interface of the AGDSS.

3.1.1.3 Data Base Subsystem (DBS)

The DBS contains the archives for documentation as well as parameters for the model base.

3.1.1.4 Model Base Subsystem (MBS)

The MBS utilizes the DBS manipulation language to assemble the necessary model building blocks into models for use by the DS and to execute those models with parameters input via the DS.

3.1.2 Mission

The mission of the AGDSS is to provide acquisition team integrity and the necessary information processing capacity, to mitigate the impact of the adverse effects of communication breakdown and filtering of information, on acquisition decision making.

3.1.3 Threat

The system is subject to the threat described in NCSC-TG-008, Version-1.

3.1.4 System Diagrams

3.1.4.1 Functional Flow Diagrams

The top functional flow diagram for the system is shown in Figure 3-1.

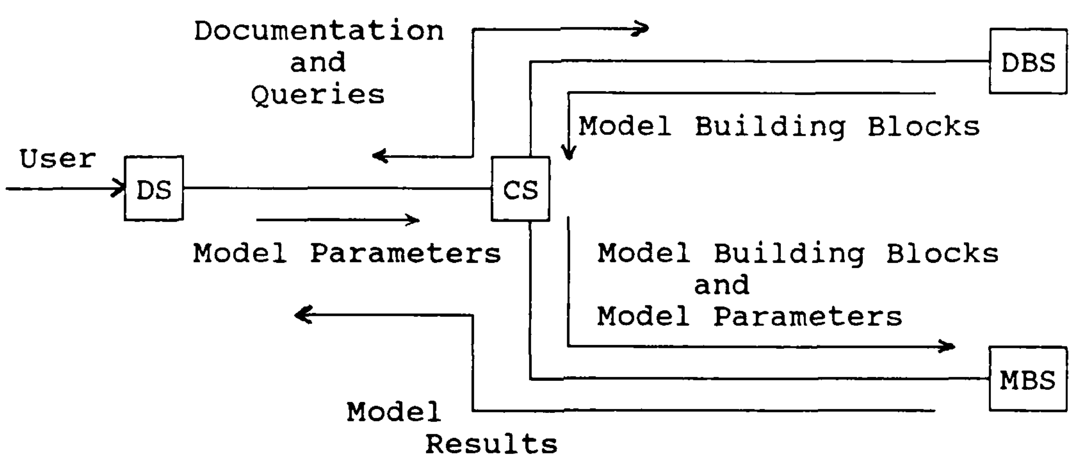

Figure 3-1. AGDSS Top Flow Diagram

3.1.4.2 Specification Tree

The specification tree for the system is shown in Figure 3-2.

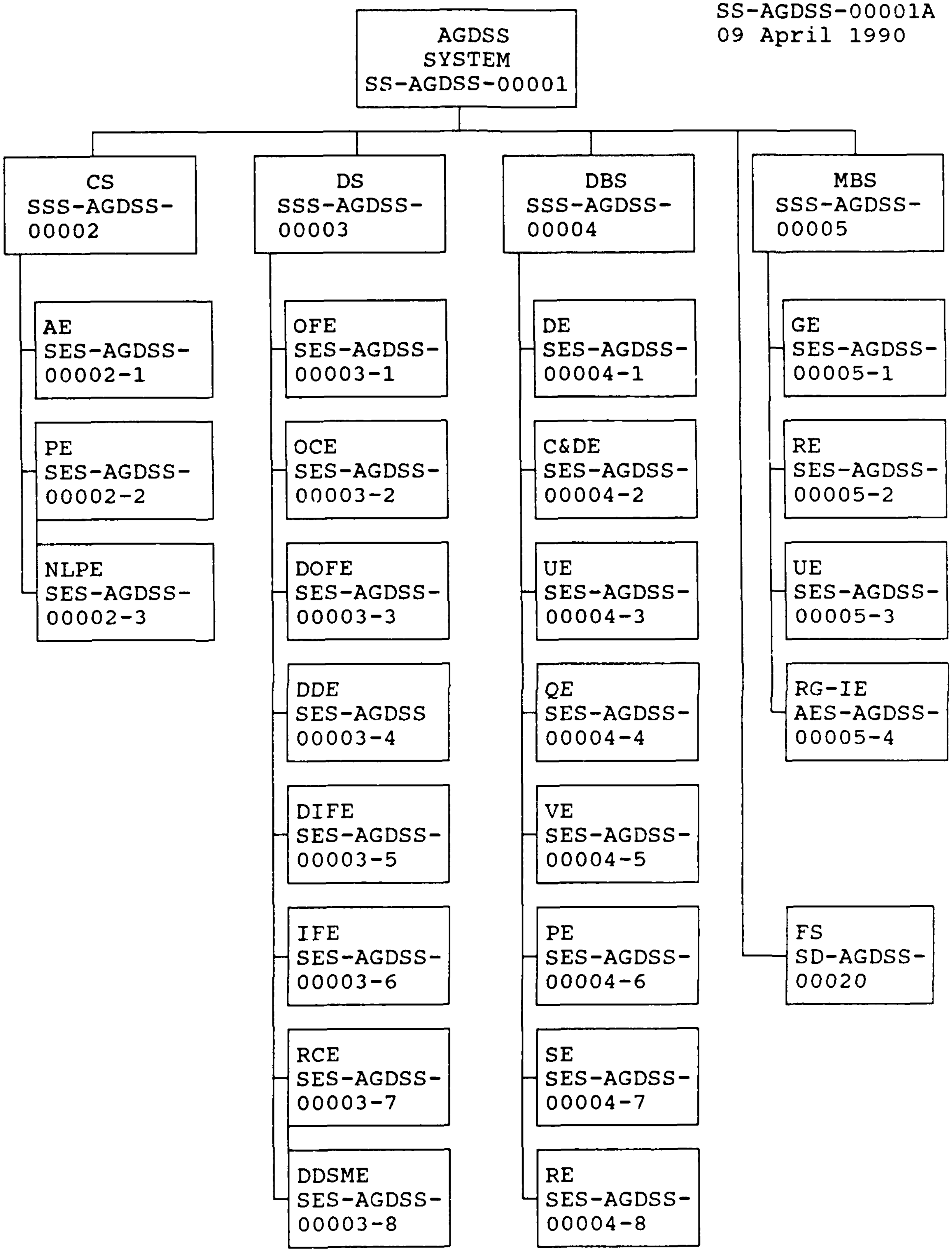

Figure 3-2. AGDSS Specification Tree

3.1.5. Interface Definition

For the purposes of this specification an interface is defined as a functional relationship, physical connection, or software/information transfer between two or more equipment/computer program entities within a system or between a system and entities external to it.

AGDSS interfaces are comprised of external, intersubsystem, and intrasubsystem categories. Interfaces existing between AGDSS entities and entities external to the AGDSS are defined to be external. Intersubsystem interfaces are defined to exist between AGDSS subsystems and between AGDSS subsystems and the Facilities Segment. Intrasubsystem interfaces are defined as those which exist between entities within an AGDSS subsystem (e.g., elements, subelements, assemblies, subassemblies, components, parts).

3.1.5.1 Intersubsystem Interfaces

AGDSS intersubsystem interfaces excluding the Facilities Segment are shown in Figure 3-3. The DS provides the MBS with model parameters and receives model results from the MBS via the CS. The model building blocks are shown leaving the DBS and entering the MBS. Finally, double-headed arrows indicate that documentation and queries require full duplex communication ties between the DS and DBS.

3.1.5.2 External Interfaces

AGDSS external interfaces are shown in Figure 3-4

3.1.5.3 Intrasubsystem Interfaces

Intrasubsystem interface requirements are defined in the lower-tier (SSS & SES) documents and the facilities intrasegment requirements are defined in the SD document of the specification tree.

3.2 CHARACTERISTICS

3.2.1 Performance Characteristics

3.2.1.1 Interoperability

The interoperability of the AGDSS subsystems will be provided by the intersubsystem interfaces (see paragraph 3.1.5.1).

3.2.2.1 Facilities

The AGDSS Facilities Segment shall be as specified in the Facility Specification (FS) SD-AGDSS-00020.

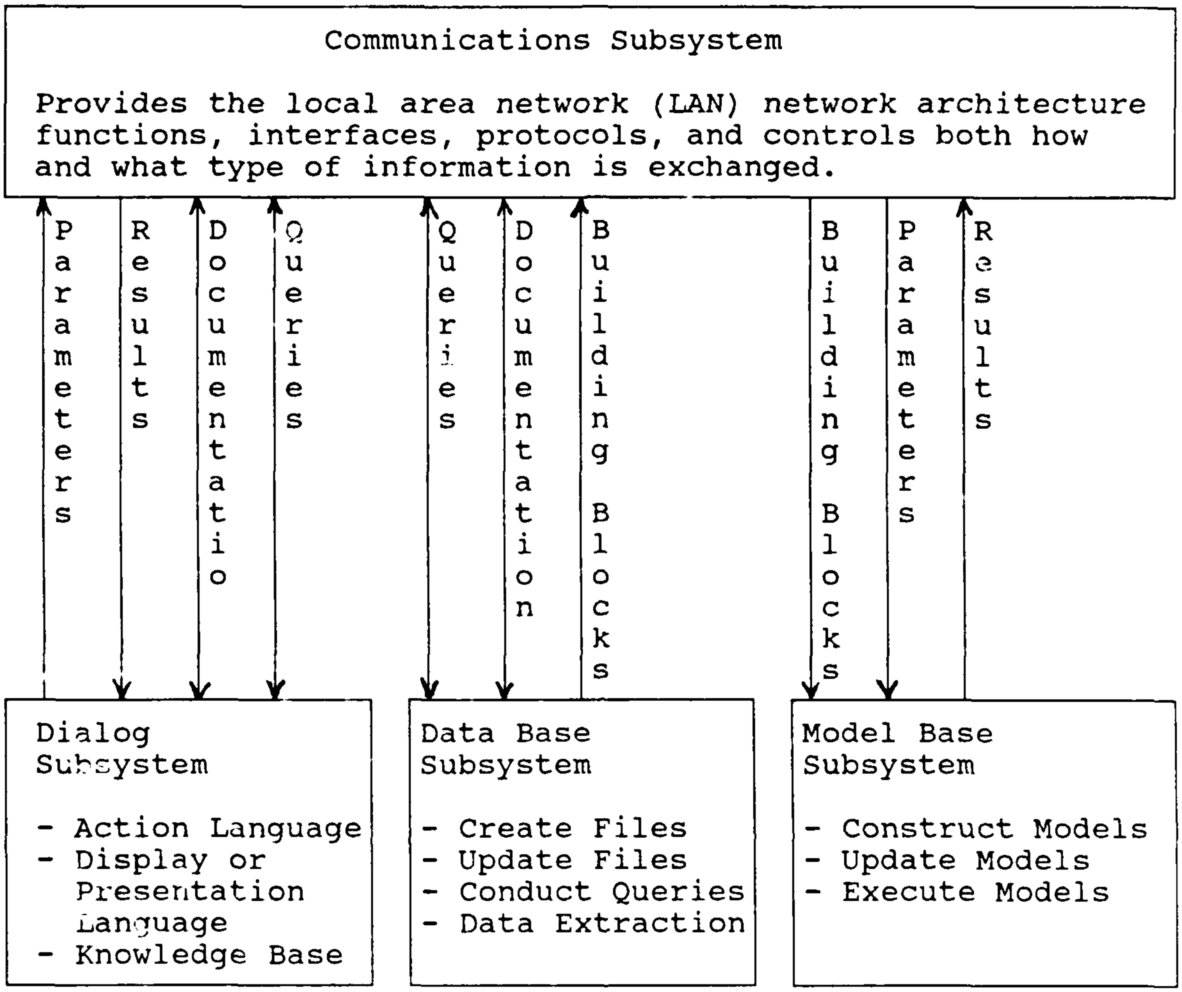

Figure 3-3. AGDSS Intersubsystem Interfaces

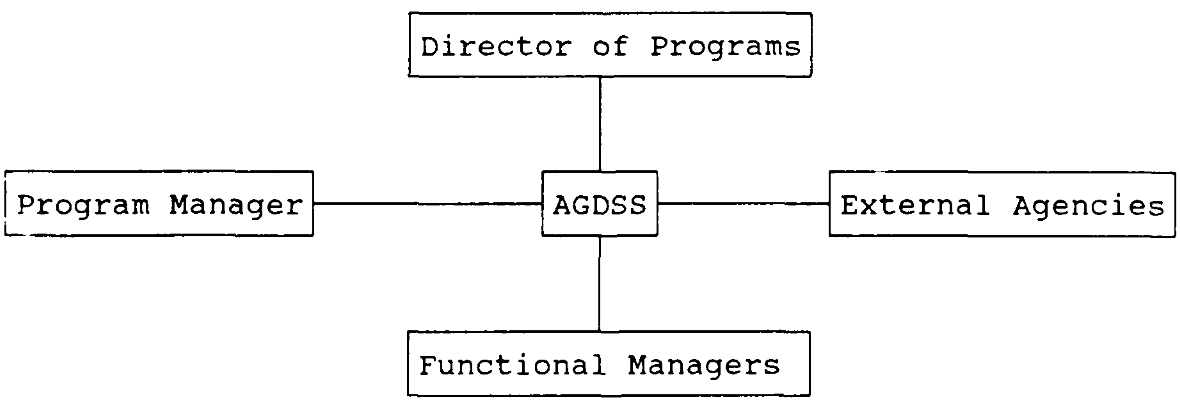

Figure 3-4. AGDSS External Interfaces

3.2.2.2 Electrical Power

The AGDSS shall be provided with facility power.

3.2.3 Reliability

AGDSS mission reliability is defined as the probability of successful AGDSS equipment support of a mission for a specified time period. Quantitative reliability requirements are derived from the mean time between critical failures (MTBCF) of the functional equipment and the time duration over which the reliability is specified.

a. The following guidelines shall be used in interpreting the requirements in this section and in 3.2.4 and 3.2.5:

 (1) The reliability, maintainability, and availability parameters defined in this specification do not include any impact due directly or indirectly to actual threats, operator errors, or software.

 (2) Redundancy may be used to obtain the required reliability figures if the redundant element is on line or is substituted for a failed element in a non-interrupting manner, or if automatic or manual switch-over can be effected in a period of time and in a manner that allows full mission continuance.

 (3) AGDSS equipment shall provide levels of reliability, availability, and maintainability sufficient to meet the applicable requirements of the AGDSS subsystems.

3.2.3.1 Subsystem and Facilities Segment Reliabilities

The AGDSS Subsystems and Facilities Segment shall have reliabilities as described below.

3.2.3.1.1 Communications Subsystem Reliability. The Communications Subsystem shall properly switch, transmit, or receive data or voice/video between any two points in the AGDSS communications network, with a reliability of 0.9995 for a period of 30 minutes.

3.2.3.1.2 Dialog Subsystem Reliability. TBD.

3.2.3.1.3 Data Base Subsystem Reliability. TBD.

3.2.3.1.4 Model Base Subsystem Reliability. TBD.

3.2.3.1.5 Facilities Segment Reliability. The AGDSS shall be provided commercial power, environmental control, and backup power through the Facilities Segment. The Facilities Segment shall have the following reliabilities:

a. The reliability of the environmental systems (temperature, humidity, etc.) shall be at least 0.99998 for a period of 8 hours.

b. The reliability of the backup power system shall be at least 0.9989 for a period of 24 hours.

3.2.3.2 Mean Time Between Critical Failures

A critical failure is defined as any equipment failure causing an unscheduled interruption which prohibits a system from successfully completing its function within the allocated time. The Mean Time Between Critical Failures (MTBCF) for AGDSS or for any AGDSS subsystem shall meet the following requirements:

a. The MTBCF shall be consistent with the reliability requirements specified in 3.2.3 and 3.2.3.1.

b. The MTBCF shall be determined using actual component or device failure rates. When such information in not available, the MTBCF may be determined analytically.

c. The MTBCF may be achieved through the application of redundant equipment, provided it complies with 3.2.3a.

3.2.4 Maintainability

Preventive maintenance and planned configuration changes are classified as scheduled maintenance. The AGDSS shall be designed to meet the following maintainability requirements:

a. Maintainability shall conform to the reliability re quirements of 3.2.3, 3.2.3.1, and availability requirements of 3.2.5.

b. Maintainability shall be:

   (1) Predicated on the necessity of continuous operations

   (2) Consistent with the logistics requirements in 3.5

c. All scheduled maintenance shall be such that it does not interfere with the support of critical operations.

d. Life-cycle costs shall be a major consideration in determining maintainability.

3.2.4.1 Mean Time to Restore

Mean Time to Restore (MTR) is the average time required to restore a function lost due to equipment failure.

a. MTR shall include both switch-over and restoration of the system to the minimum configuration required to support a mission.

b. MTR may include any or all of the following steps: isolation, disassembly, reassembly, re-boot, and check out. The duration starts at the report of system malfunction and ends at completion of system restoration.

3.2.4.2 Mean Time Between Maintenance Actions

Mean Time Between Maintenance Actions (MTBMA) is the total number of system life units divided by the total number of maintenance actions (preventive and corrective) during a stated period of time. The MTBMA for each subsystem shall be (TBD).

3.2.4.3 Maximum Continuous Downtime

The 90th percentile of downtime distribution of a given AGDSS function is defined as Maximum Continuous Downtime (Mmax). Assuming that all resources for support of a given function are available at the start of the downing event and that maintenance personnel are on site, Mmax for both scheduled and unscheduled maintenance shall not exceed the following values.

	Function	Mmax	MTBMA
a.	Communications Subsystem	60 minutes	(TBD)
b.	Dialog Subsystem	30 minutes	(TBD)
c.	Data Base Subsystem	60 minutes	(TBD)
d.	Model Base Subsystem	60 minutes	(TBD)

3.2.5 Availability

Availability (Ao) is the probability an item is in an operable and committable state at the start of a mission, when the mission is called for at a random time. Availability requirements are established in terms of MTBCF, MTR, and Scheduled Maintenance (SM):

$$Ao = MTBCF / [MTBCF + MTR + (SM * MTBCF / SM\ INTERVAL)]$$

SM is the average of total downtime per maintenance interval, resulting from preventive maintenance, overhaul, and other predetermined maintenance procedures during which the system cannot perform its mission. The maintenance interval is a periodic time interval encompassing both the downtime durations and the elapsed time between scheduled maintenance actions.

When scheduled maintenance can be scheduled around the required subsystem function it does not affect the availability and the term involving SM is correspondingly zero in the availability equation.

a. The equipment configuration required to support a real-time dialog session (single or multiple user/system interaction without video conferencing) shall have an availability equal to 0.995.

b. The equipment configuration required to support a real time dialog session with video conferencing shall have an availability equal to 0.990.

c. The Uninterruptible Power Supply shall have an availability of at least 0.99999 for regulation and smoothing functions and 0.99999 for uninterrupted power supply functions.

3.2.6 Environmental Conditions

Environmental conditions and requirements (physical and space) design criteria for AGDSS equipment and facilities shall be as specified in the Facility Specification (FS), SD-AGDSS-00020.

3.2.7 Security

The AGDSS shall provide a secure operational environment to promote mission assurance and survivability, and to protect classified information from compromise.

3.2.7.1 Information Security

The AGDSS shall provide capabilities to protect classified information against unauthorized modifications or disclosure commensurate with the level of classification assigned under varying conditions which may arise in connection with its use, dissemination, storage, movement or transmission, and destruction.

3.2.7.2 Communications Security

The AGDSS shall be designed to provide communications security (COMSEC) such that classified information transmitted over internal and external telecommunications networks, systems, and circuits shall be protected.

3.2.7.3 TEMPEST Security

AGDSS equipment shall provide TEMPEST protection to control compromising emanations compatible with, and not redundant to, the TEMPEST protection provided by the Facilities Segment.

3.2.7.4 Automated Data Processing System Security

AGDSS automated data processing shall:

a. Have an explicitly defined set of access controls based on classification, user clearance, and established need to know.

b. Provide users (1) access to all the information for which they are authorized, and (2) deny access to information for which they are not authorized.

3.3 DESIGN AND CONSTRUCTION

Newly designed equipment shall be designed and constructed in accordance with high-quality commercial practices except where higher quality practices are specified. The AGDSS shall utilize, to the maximum extent practical, equipment and software already acquired and/or developed for acquisition office automation, consistent with achieving cost-effective design and development functions and maintaining compatibility, interoperability, and supportability at the AGDSS.

3.3.1 Materials, Processes, and Parts

Materials, processes, and parts shall meet the following requirements:

a. Commonality in materials, processes, and parts shall be a major criterion in their selection to minimize the variety of parts, related tools, and test equipment required in the fabrication, installation, and maintenance of the system.

b. The materials, processes, and parts selected shall be of sufficient proven quality to allow the equipment to meet

the functional performance, reliability, and strength requirements during the applicable life cycle, including all environmental degradation effects.

3.3.1.1 Parts Standardization

Standardized off-the-shelf parts shall be used wherever compatible with interoperability and life-cycle cost constraints.

3.3.2 Safety

Systems safety engineering principles to provide protection against personal injury and/or damage to equipment shall be applied throughout the design, development, manufacture, test, installation, and checkout of the AGDSS equipment and facilities in accordance with MIL-STD-454H where applicable. Occupational Safety shall be in accordance with AFOSH STD 127-64.

3.3.3 Expandability

The AGDSS shall be developed such that upgrading of capabilities may be accomplished without degrading on-going operations.

3.4 DOCUMENTATION

AGDSS documentation requirements are as follows:

a. Documentation of new and existing equipment and software shall support design, testing, inspection, installation, operation, and maintenance.

b. Existing documentation shall be utilized where practical when software or equipment components are replicated.

c. The term software shall include firmware.

3.4.1 Specifications

The AGDSS specification tree, Figure 3-2, shall control lower tier specification trees for system subsystems and the Facilities Segment and for Configuration Items (CIs) and Computer Program Configuration Items (CPCIs).

3.4.2 Drawings

Drawings shall be provided as follows:

3.4.2.1 Program Peculiar Items

New design shall be supported with equipment drawings and listings sufficient to provide remanufacture, provisioning, fabrication, installation, and reprocurement activities.

3.4.2.2 Off-the-Shelf or Commercial Equipment

Drawing information shall be sufficient to support maintenance and repair activities and to permit reprocurement in accordance with subsystem/segment contracts.

3.4.3 Technical Manuals

Operation and maintenance manuals for equipment and software shall incorporate levels of detail compatible with AGDSS staffing.

3.5 LOGISTICS

3.5.1 Logistics Support

The AGDSS shall include the following logistics considerations.

a. The AGDSS shall be designed with supportability as a major criterion.

b. Provisions for a maintenance program shall be made to allow flexibility and trade-offs between maintainability and reliability.

3.5.2 Maintenance

AGDSS maintenance considerations shall include the following:

a. Design shall accomodate maximum utilization of component modularity to enhance removal and replacement maintenance action on the installed equipment and minimize downtime.

b. All Line Replaceable Units (LRUs) shall be readily accessible to ease maintenance action.

c. AGDSS maintenance shall be consistent with time constraints imposed by mission schedules.

d. The AGDSS design shall be compatible with technician level skill requirements for maintenance. The maintenance and skill level requirements will be:

(1) Determined so that organizational/intermediate maintenance can be performed down to the subassembly level. Design will accommodate depot level maintenance to the part level.

(2) Determined by Logistic Support Analysis and Repair Level Analysis

(3) Established in accordance with the AGDSS maintenance concept.

e. Design shall accomodate the employment of a mix of military, in-service civilians, and contractor personnel to carry out on-equipment and off-equipment maintenance.

f. The AGDSS system shall be designed to incorporate maximum use of automated, built-in test/built-in fault isolation capability to diagnose and isolate failures to the designated LRU level.

g. Where automated or manual support equipment is required, government inventory items, modified inventory items, or commercial off-the-shelf items shall be used to the maximum extent with new design kept to a minimum.

3.5.2.1 Testability

Provisions shall be made for fault isolation tests using automated built-in fault isolation capability which identifies the failed Line Replaceable Unit.

3.5.2.1.1 Test and Evaluation Support. Each AGDSS subsystem shall provide the capility to support individual and integrated testing during Development Test and Evaluation (DT&E), and integrated testing during Initial Operational Test and Evaluation (IOT&E), and Follow-On Operational Test and Evaluation (FOT&E).

3.5.2.2 Scheduled and Unscheduled Maintenance

The AGDSS design shall accommodate the following approach to scheduled and unscheduled maintenance:

a. Scheduled preventive maintenance and engineering changes without interfering with critical operations support

b. Unscheduled corrective maintenance including actions required to inspect, service, calibrate, and repair equipment.

3.5.3 Supply

Supply requirements shall be integrated into the development phase of new or modified equipment and identified during the acquisition of commercial equipment to establish and provide a supportable, cost-effective logistics system for all subsystems and the Facilities Segment of the AGDSS, compatible with the government supply system.

3.6 PERSONNEL AND TRAINING

3.6.1 Personnel

Personnel considerations shall include the following.

a. The AGDSS shall be designed and built to be operated and maintained principally by military personnel not expected to have extensive scientific or engineering training. In addition, DoD civilian and contract civilian personnel will be used.

b. Personnel not possessing data processing and/or computer maintenance backgrounds, shall be provided the necessary prerequisite training.

3.6.2 Training

The AGDSS shall provide training capabilities for operations personnel and maintenance personnel to the performance levels required by AGDSS operations and maintenance. Training shall be consistent with requirements defined in the AGDSS Master Training Plan.

3.6.2.1 Operations

3.7 FUNCTIONAL AREA CHARACTERISTICS

3.7.1 Communications Subsystem (CS) Operations

The CS shall provide an Application Element (AE), a Presentation Element (PE), and a Network Link Physical Element (NLPE).

3.7.1.1 Application Element

The AE functions are described in the following paragraphs which contain excerpts from Bui and Jarke, 1986, p. 16.

3.7.1.1.1 Group Norm Monitor. The group norm monitor shall provide a flexible and adjustable mechanism for monitoring

communications transfers between individual DSS to predict in advance the definition of group decision making frameworks.

3.7.1.1.2 Group Norm Filter (GNF). The GNF shall enforce the defined protocols of the Group Norm Constructor (GNC) whenever a communication activity is triggered by the AGDSS users. When a data transfer is requested, the GNF shall:

a. Check whether or not the communication desired corresponds to the preset protocol.

b. If the request is in accordance with the protocols, it shall be transferred to the next communications routine.

c. Otherwise, the GNF shall notify the user of the violation and offer him/her the current communications protocols pattern, if requested.

3.7.1.1.3 Invocation Mechanism (IM). The IM shall provide for modification of the communications protocols previously set via the GNC. The IM shall:

a. be triggered by a user's request

b. determine when and how to convene the other users to debate and vote on the motion.

3.7.1.2 Presentation Element

The PE function is described in the following paragraph containing excerpts from Bui and Jarke, 1986, p. 16.

3.7.1.2.1 DSS-to-AGDSS Document Formatter (DADF). The DADF shall contain to the extent practical, presentation protocols for any possible type of data exchange in a group decision situation. Examples of such protocols are those related to data structures that are shared between the individual DSS model components and the AGDSS model component. For instance, in a voting procedure, data must be compressed before being reported to individual members.

3.7.1.3 Network Link Physical Element

The NLPE shall perform the functions of layers 1-5 of the Open Systems Interconnection (ISO) Reference Model.

3.7.2 DS Operations

The DS shall provide the following elements as described in the following paragraphs containing excerpts from Sprague and

Carlson, 1982, pp. 214-216: an Output Formatter Element (OFE), an Output Constructor Element (OCE), a Device Output Functions Element (DOFE), a Device Driver Element (DDE), a Device Input Functions Element (DIFE), an Input Formatter Element (IFE), a Response Constructor Element (RCE), and a Dialog Data Structure Manager Element (DDSME). The values and attributes associated with the function of these elements shall not be specific to any interface hardware, so as to permit the dialog subsystem to support a variety of hardware.

3.7.2.1 Ouput Formatter Element

The OFE shall translate commands and data into data structures containing the values (e.g., text strings) and attributes (e. g., color, position, size), describing the output representations (how the values are to be displayed).

3.7.2.2 Output Constructor Element

The OCE shall translate the dialog data structure into commands to create an output representation on one or more devices.

3.7.2.3 Device Output Functions Element

The DOFE shall generate device-specific commands to create outputs on one or more specific devices.

3.7.2.4 Device Driver Element

The DDE shall send the DOFE commands to the device, wait for user inputs, or request user inputs if the output message is an interrupt rather than commands to generate a representation. When user inputs are received, the DDE shall buffer the inputs and send the inputs to the device input functions element.

3.7.2.5 Device Input Functions Element

The DIFE shall translate specific inputs into device independent inputs.

3.7.2.6 Input Formatter Element

The IFE shall translate the user's input into a set of action-object pairs. The action describes the user's input action (e.g., keyboard keystroke). The object designates which object in the output representation that was affected by the action (e.g., new value or attribute for a menu item).

3.7.2.7 Response Constructor Element

The RCE shall use a set of action-object pairs to create commands and data for the other components of the DSS e.g., update a data base field corresponding to the field in the output representation into which the user had just typed a new value.

3.7.2.8 Dialog Data Structure Manager Element

The DDSME shall store and retrieve data used by the dialog component, such as the data structure that describes the output representation.

3.7.3 DBS Operations

The DBS shall provide data base management system (DBMS) operations utilizing optimization and a data extraction design. Optimization techniques such as automatic file reorganization, access path optimization, and operation batching shall be employed to increase the performance of the operations. Data extraction shall provide for interfacing a variety of AGDSS source data bases with each other. The DBMS operations are described in the following paragraphs which contain excerpts from Sprague and Carlson, 1982, pp. 236-239: a Dictionary Element (DE), a Creation and Deletion Element (C&DE), an Update Element (UE), a Query Element (QE), a View Element (VE), a Protection Element (PE), a Sharing Element (SE), and a Recovery Element (RE).

3.7.3.1 Dictionary Element

The DE shall support data base dictionary functions such as adding new entries, deleting entries, retrieving information on the entries, and maintaining multiple indices (e.g., data name, date created, responsible organization). The DE functions shall be integrated with the other DBS operations such that for example, deleting an item from the dictionary should result in deleting it from the data base.

3.7.3.2 Creation and Deletion Element

The C&DE shall support addition and subtraction of objects in the data base in accordance with the tvpe of creation and selection operations permitted by the data base model.

3.7.3.3 Update Element

The UE shall permit values to be replaced in the data base.

3.7.3.4 Query Element

The QE shall support the selection and manipulation of records and fields in the data base.

3.7.3.5 View Element

The VE shall provide customized data structures (data bases, records, or fields) by defining a subset, aggregation, or other combination of the data base.

3.7.3.6 Protection Element

The PE shall provide restrictions to control unauthorized usage of DBMS functions.

3.7.3.7 Sharing Element

The SE shall determine how many users can have simultaneous access to the data base. If sharing is permitted, the SE shall provide locking functions to prevent users from accessing inconsistent data and preventing "deadlock" (preventing each other from proceeding).

3.7.3.8 Recovery Element

The RE shall provide the capability to restore the data base to a consistent state after either a hardware (disk) failure or after a software (program) failure. The RE shall checkpoint and log the data base on a separate file for recovery purposes. In the event of a failure, the data base shall be recovered by applying the sequence of operations in the log (create, update, and delete) to the most recent checkpoint.

3.7.4 MBS Operations

The MBS shall provide a model base management system (MBMS) analogous to a DBMS, with the following elements as described in the following paragraphs which contain excerpts from Sprague and Carlson, 1982, p. 262: a Generation Element (GE), a Restructure Element (RE), an Update Element (UE), and a Report Generation-Inquiry Element (RG-IE).

3.7.4.1 Generation Element

The GE shall provide a mechanism for building or generating models. This mechanism shall be designed to accommodate change in user needs as well as technology.

3.7.4.2 Restructure Element

The RE shall provide a way to redefine or restructure a model in response to changes in the modeled situation.

3.7.4.3 Update Element

The UE shall provide a procedure for updating a model in response to change in data (e.g., a revised parameter estimate without change in structure).

3.7.4.4 Report Generation-Inquiry Element

The RG-IE shall provide for operation of the model to obtain the decision support desired. Alternative forms may be:

a. Periodic run of a well-established model

b. Special results from an ad hoc model

c. Use of data analysis models

d. Iterative rerun of a model or set of models

e. The sequential run of a set of interrelated models according to a predefined procedure.

3.8 PRECEDENCE

3.8.1 Conflicts

In the event of conflict between the documents referenced herein and this specification, the contents of this specification shall prevail. Unresolved conflicts shall be directed to the contracting officer or delegated representative for resolution.

4. QUALITY ASSURANCE PROVISIONS

Quality assurance provisions shall be performed in a manner consistent with the requirements of this specification.

5. PREPARATION FOR DELIVERY

Not Applicable.

6. NOTES

Reserved.

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